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Ergonomics evaluation of task demands among kitchen staff

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ERGONOMICS EVALUATION OF TASK DEMANDS AMONG KITCHEN STAFF

An Abstract of a Thesis
Submitted
in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Jaqueline Pereira da Silva
University of Northern Iowa
December 2012

ABSTRACT

The purpose of this study was to evaluate the workplace demands faced by a group of kitchen staff at six dining centers and to survey musculoskeletal complaints among this sample of workers. The dining centers were located in six different public elementary and middle schools in a city in the south of Brazil. This research was developed following qualitative research design, and the researcher made use of the "Activity Oriented Ergonomics (AOE) methodology.

The AOE focuses on the work analysis that evaluates real work situations that allows a reassessment of work demands. In this case the chosen methodology was a good fit in order to detect issues that can be harmful to workers health regarding ergonomics criteria in the kitchen workplace environment.

The researcher applied different means to conduct the data collection process which included workplace analytical observation, tasks observation, informal conversation with cooks and manager, as well as evaluating tools, forms, and questionnaires. Thus, the observation of the workplace and workers performing their functions focused in analyzing individuals' operational behavior related to their work requirements.

Data was organized in three different topics including characteristics of participants, workplace environmental

conditions, and task analysis, which contains physical and cognitive demands. The analysis of the workplace environment condition emphasized two main topics: 1) layout characteristics of the workplace area such as physical space and equipment aspects; 2) ambiance conditions, which comprises aspects of temperature/humidity, luminosity, and noise. There were essentially four activities that were performed in the workplace, which were food pre-preparation, cooking, meal distribution, and cleaning/sanitation.

Finally, recommendations were made in order to improve the working conditions of the staff as well as their knowledge and awareness regarding everyday aspects of ergonomics. The betterment of ergonomics factors, organizational matters, and environmental aspects can be ultimately beneficial to employees. Importantly, these changes will also benefit the business as a whole, since employees will not only be more productive but also willing to take on the work effectively.

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This Study by: Jaqueline Pereira da Silva

Entitled: ERGONOMICS EVALUATION OF TASK DEMANDS AMONG
KITCHEN STAFF

has been approved as meeting the thesis requirement for the
Degree of Master of Science in Industrial Technology -
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DEDICATION

In loving memory of my grandmother, Maria de Miranda Pereira (1932-2008), who always emphasized the importance of education and whom I miss dearly.

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There are a number of people without whom this thesis would not have been completed, and to whom I am greatly indebted. First, I would like to thank my advisor Dr. Julie Zhang and the members of my thesis committee Dr. Ali Kashef and Dr. Fabio Fontana for their time and generous support. Second, I would like to thank my husband for his sage advice, insightful criticism, and encouragement. Finally, I would like to thank my family, for their unconditional support and love. Thank you to my father and mother, Potiguara da Silva and Maria Luiza Pereira da Silva, and my sister Janine Pereira da Silva.

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CHAPTER I

INTRODUCTION

Ergonomics is an area of knowledge that aims at transforming the workplace, adapting it according to the characteristics of individuals and the characteristics of their tasks (Iida, 1992). Ergonomics focuses on analyzing activities that take place at real work situations. Its objective is to humanize work, defending the premise that it must be adapted according to the characteristics of the users in conjunction with socio-technical requirements, objectives to be achieved, and the given working conditions (Bridger, 1995).

Oborne(1987) claimed that working conditions are related to everything that influences or determines activities at the workplace; in other words, working conditions can be understood as the union of internal and external factors at work, such as work journey (shifts, breaks), the amount of leisure (rest, vacation, retirement), medical service, and transportation service.

According to MacLeod (1995), ergonomics helps to determine the components of the workload, divided into three categories:

- The physical - relates to gestures, postures, and the displacement of workers, which is necessary to execute tasks;
- The cognitive - relates to the mental and perceptual functions required to complete certain work tasks (memory, attention, hearing, vision, etc.);
- The psychic - focuses on the importance of the context, nature, and organization applied to each employee.

Ergonomics, therefore, determines people's degree of existential, realization, and/or psychological distress. Whereas the nature of the work is defined from the analysis of a predominant workload, it is necessary to emphasize that, whichever the activity may be, the three categories mentioned above will always be present. However, one will most likely stand out among the others (MacLeod, 1995).

An important topic in the study of ergonomics concerns the phenomenon of work-related musculoskeletal disorders (WMSDs). WMSDs are a multifactorial disease resulting from a number of work components that act in a combined way.

Accordingly, it requires investigation following ergonomics principles aiming at adapting the work to the human being. In this sense, the main goal is to find solutions that primarily promote workers well-being in conjunction with their efficiency and effectiveness when performing their tasks (Violante, Kilbom, & Armstrong, 2000).

When investigating work-related musculoskeletal disorders (WMSDs), the focus is usually directed at employees who are placed in a context of production of goods and/or services. This implies that these workers are subject to a variety of requirements inherent in the work itself, and that they do not have the autonomy to change such requirements (Kuorinka, 1995).

The present study made use of the baseline data of an ergonomic evaluation research carried out among kitchen workers in six different public elementary and middle schools in Brazil. This study will provide school kitchen personnel the information on how to better exercise their daily functions at work. More specifically, the cooks will have more knowledge about how they can make their work environment safer, more effective, and less harmful to their health.

The school administrators will be given directions for what needs to be changed in order for the kitchen personnel to experience better and safer working conditions.

Statement of the Problem

The problem which the present study addressed was to identify issues that can be harmful to workers health regarding ergonomics criteria in the kitchen workplace environment.

Statement of Purpose

Work related musculoskeletal disorders have been a primary cause of morbidity within the restaurant industry, which greatly affects work satisfaction, effectiveness, and productivity (Violante, Kilbom, & Armstrong, 2000). Therefore, it is also considered by specialists to be the main reason for work-related sickness absence (Dempsey & Filiaggi, 2006).

Accordingly, the purpose of this study was to evaluate, following ergonomics criteria, the workplace conditions of a group of kitchen staff at six dining centers, and to survey musculoskeletal complaints among this sample of workers. Finally, recommendations were made in order to improve the working conditions of the staff as well as

their knowledge and awareness regarding everyday aspects of ergonomics.

Statement of Need

Although many ergonomics studies have evaluated workplace conditions, particularly office areas, very few studies have evaluated dining center kitchens. One of the few studies to address dining center kitchens is that of Das and Wimpee (2002), who developed a study in a determined hospital regarding postural distress in different regions of the body of the meal service personnel. The authors addressed multiple issues related to a hospital meal cart functionality and operation process. They also emphasized the fact that when the cart was loaded exceeded the acceptable push force requirement of 5th percentile female standard. During the ergonomic evaluation the authors identified various ergonomics problems, which only could be fixed by redesigning a new model of the existing cart. The authors suggested some design modifications with regard to, among others, air tight or solid transparent plastic doors, vertical handles, two swivel locking and two stationary casters, individually heated plates for soup and main meals. Successfully, such modifications were adopted by the manufacturer in the new version of the cart.

Chyan, Du, Yeh, and Li (2004) led a research in five-star hotels in Taiwan in order to identify specific body site work related musculoskeletal disorders, pain intensity, and strategies for pain relief among a sample of restaurant workers. The authors concluded that 84% of the workers experienced work related musculoskeletal disorders with the highest prevalence rate found for the shoulder (58%).

Therefore, Bohr, Dale, Evanoff, Grayson, and Wolf (2005) presented that work-related musculoskeletal disorders (WMSDs) affect an estimated 19 million people per year in the United States, which consequently results in loss of workdays and raises the compensation costs of workers nationwide. To substantially reduce these statistics numbers, modifications at the workplace, which will enable the work to be completed with better ergonomic interface, need to be accomplished.

Furthermore, Bohr, Dale, Evanoff, Grayson, and Wolf (2005) conducted a study in order to identify a way to execute simple job changes that would help workers to return safely to their usual job duties. In addition, they also attempted to identify ways to alter the workers' job so that the injured worker could perform job functions while maintaining work-related restrictions. In their study,

the results showed that after ergonomic evaluations were accomplished, most of the ergonomics principles were totally or partially implemented, with such modifications at the worksite consequently addressing behavior changes by the employees. Accordingly, the modifications performed interposed to reduce physical stressors at the workplace, thus helping injured staff to return to work, preventing further injuries, and decreasing waste of time.

Dempsey and Filiaggi (2006) performed a study in restaurants in the eastern region of the USA to investigate work related musculoskeletal disorder issues as well as work environment challenges confronted by attendant staff. Heavier tray lifts and carries were subjects of concern, as well as slip and fall issues that increase the risks of injuries when these tasks are being performed. Consequently, the authors reported that 42% of the investigated workers presented musculoskeletal illness symptoms more frequently in the lower back area (18%) and shoulder (11%).

More recently, a group of researchers in Finland analyzed fifty-nine municipal kitchens in order to find the best result regarding musculoskeletal load problems faced by the employees. The researchers observed that more than a need of improvement in the workplace was necessary, that is,

they would have to make the employees conscious about the importance of ergonomics and the difference that such matter could make in their lives. To start solving the issues the specialists detected, eight workshops were organized by them to teach and train workers ergonomics matters specifically related to their work in the kitchen. Moreover, the team evaluated the current conditions and performed some modification at the work environment to better suit all the staff. Accordingly, the improvements led to noticeable changes in the workers behavior, motivation, and attitude. By decreasing physical load the kitchen staff presented great improvements in their musculoskeletal health (Pehkonen et al., 2009).

Research Questions

The researcher adopted a qualitative research design to conduct this study as it best fits its purpose of analyzing and evaluating individuals' work and their workplace conditions regarding ergonomics aspects. The questions that are essential to the understanding of the nuances of tasks and activities at the workplace addressed by the study are:

1. What is requested from the subject?

2. What does the subject need to know to execute his/her task properly?
3. What activity does the subject perform effectively?
4. Do individuals perform their work following ergonomics principles?
5. How is the interaction between requested and conducted work?

As a result, the answer to these questions favors to identify the nature of the workload present in some particular activities (Macleod, 1995).

Assumptions

It has been assumed by the author of the present study that:

1. The sample of workers selected would properly serve as a parameter to conduct ergonomics improvements in the workplace, therefore benefiting the entire group of staff members at the chosen units.
2. The workers selected for the study were truthful and sincere throughout the research process.
3. The results of the study can be utilized to improve working conditions in similar establishments.
4. The workers were able to read and understand the questionnaire in the survey.

Limitations

In the course of the study, limitations were identified, as well as complementary research suggestions.

1. The limited number of employees evaluated in this project given the fact that the school kitchen were small and served a relatively small student population.
2. The fact that just six sites were investigated, when there are hundreds of schools in the city where these six schools are located.
3. Only four cooks from one of the six dining centers participated in an in-depth study observation. The selection was made based on the fact that the chosen kitchen was the one that had the highest demand when compared to the other kitchens.
4. The fact that the researcher conducted informal conversations with the cooks and the manager instead of interviewing them. Informal conversations were chosen, however, because they are part of the cultural understanding in Brazil, i.e., subjects will be more willing to respond to questions if they sense it is part of a conversation versus a formal interview.
5. The fact that there is no representative of the male gender, since all cooks in this study are women.

6. High turnover of the employees, since most of the cooks had been working at the school for an average of only two and a half years.

Statement of Procedure

Dining center kitchens were selected for this study. The objective of the research was first explained to the establishment administration personnel. Participation was then negotiated and the steps of the study were also particularly discussed, such as for how long the subjects would be involved, how long the data collection would last, and how the information was going to be gathered and processed.

The researcher acquired approval from the University of Northern Iowa Institutional Review Board (IRB), which is a special committee that reviews all research protocols involving human participants.

The first part of the data collection was performed before the dining center opened to public and after it was closed. At this time, the workplace layout was analyzed. The second part of the data collection process was conducted during the period of time that the dining center was open to customers. During this period, the researcher was observing what types and how tasks were being performed

by the staff sample. Finally, the last procedure was the application of questionnaires. Questionnaires were placed in a box located in the lunch break area. The data collection was completed a week later when the researcher gathered the questionnaires from the drop box that still was placed in the lunch break area.

After the data collection, all the information was then organized and analyzed in order to answer the research questions.

Definition of Terms

Ergonomics

"The scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance" (International Ergonomics Association).

Ergonomist

"A person trained in or working in ergonomics" (Merriam-Webster Dictionary).

Biomechanics

"The study of the structure and function of biological systems by means of the methods of mechanics" (Hatze, 1974, American Society of Biomechanics).

Anthropometry

"The study of measurements of the human body in terms of size, mass, shape, joint properties, physical strength, and joint range of motion" (Bowler & Cone, 1999, p. 151).

Task Analysis

"A formal or semiformal attempt to define and state what the user/operator/ is actually going to do with the product/system/environment in question" (Pheasant & Haslegrave, 2006, p. 13).

Injury

"A traumatic event in which the integrity of the tissue in question is violated and its mechanical order has been perturbed" (Kumar, 1999, p. 4).

Work-Related Musculoskeletal Disorders (WMSDs)

"Impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves or the localised blood circulation system that are caused or aggravated primarily by the performance of work and by the effects of the

immediate environment in which work is carried out"

(European Agency for Safety and Health at Work, 2007).

Body Mass Index (BMI)

"A simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2)" (World Health Organization, 2010).

Cross-Contamination

"The act of spreading bacteria and viruses from one surface to another. Since blood borne viruses can live on objects and surfaces for up to a week, germs could be spread when surfaces are not disinfected the right way or if equipment is not cleaned and sterilized" (Centers for Disease Control and Prevention, 2010).

CHAPTER II

LITERATURE REVIEW

This chapter refers to the review of the literature, and it was divided into three topics. The first focuses on ergonomics, its origins, and its implementation aspects. The second topic mentioned in this chapter relates to the phenomenon of work-related musculoskeletal disorders (WMSDs), which are potential illnesses that can be originated by lack of ergonomics.

Ergonomics

The term Ergonomics is derived from the Greek words *érgon*, which means task, and *nomos*, meaning law or principle. The concept was created by Wojciech Jastrzebowski in 1857 in his article entitled "An Outline of Ergonomics, or the Science of Work Based upon the Truths Drawn from the Science of Nature." Jastrzebowski (1857) was careful to specify that his purpose was that the word "work" would carry an ample definition as the "Science of Work, understood as Work in the comprehensive and integral sense, not merely its part that is physical labour or toil, but physical, aesthetic, rational, and moral work, that is Labour, Entertainment, Reasoning, and Dedication."

However, only in 1949 when the Ergonomics Research Society was created in England, ergonomics has become the term used in the industrialized world.

Ergonomics can be defined as an anthropocentric scientific approach that is based on interdisciplinary knowledge of the humanities to, in one way, match products and technologies with the characteristics of users, and in the other, to humanize the socio-technical framework, thus adapting it to both subject and/or group and the demands of the tasks (Oborne, Leal, Saran, Shipley, and Stewart, 1993).

The International Ergonomics Association created in 1961 defines ergonomics as "The scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."

That being said, ergonomics is an interdisciplinary science drawing from engineering, psychology, safety, health and medical disciplines. Therefore, as an area of knowledge, this shows that the boundaries between disciplines which study the work are increasingly tenuous (Sanders & McCormick, 1987).

Furthermore, ergonomics can be encompassed as two distinct yet complementary concepts. The first, also known as Human Factors, is associated with methods and technologies focused on the continuous need to adapt the machine to fit the individual. This term has its basis on psychology. The second concept focuses more specifically on the study of human labor in order to adapt it to the human being. This approach is centered on the performed task, focusing on the study of the interrelationship between the individual and the production of goods and/or services framework (Schlick, 2009).

One of the ergonomics issues is to know what workers actually do, how they do their job, and why they do it. The activity that a person performs within his/her work environment comprises a constant process to build mediation strategies. These strategies are the result of the individual's interaction with a given task, which conveys a human cost for the work. The human cost compromises physical, cognitive, and affective requirements. Thus, those three aspects are integrated, which means that when one is overloaded, consequently, the other two are going to suffer some sort of alteration (Pheasant & Haslegrave, 2006).

In this sense, the ergonomist professional must adjust the context of the work in a way that endeavors workers' health while enhancing their capabilities, which ultimately will lead to productivity. In order to make conscious ergonomics evaluations it is imperative to consider some essential items, such as work space layout, architectural and environmental features, among others (Pheasant & Haslegrave, 2006).

Work Space Layout

What is meant by layout? Some authors call it spatial configuration, while others call it physical arrangement. According to the Merriam-Webster Online Dictionary, "layout is the plan or design or arrangement of something laid out."

Iida (1992, p.153) states that "physical arrangement is the study of spatial distribution or the relative positioning of various elements that composes the workplace."

A workplace layout can be considered as a systematic study that seeks the optimum combination of facilities, materials, and people who perform a job, within an available space. Thus, the layout of an environment is not only the physical arrangement of furniture and equipments,

but also the combination of multiple units that constitute an organization (Fraser, 1989).

Consequently, when developing a layout, it is important to respect the functions for which it was intended, as well as the rules of occupation, considering the users' characteristics, needs, and their activities. Since one of ergonomics main goals is to adapt humans' workplaces in order to improve their quality of life, the literature suggests at least three factors to be acknowledged: worker's comfort, safety, and efficacy (Pheasant & Haslegrave, 2006).

Therefore, when integrating these principles while either designing or redesigning a determined workspace, it is assumed that it is feasible to reconcile the limits imposed by the existing architectural features. The possibility to intervene in the construction project at the time of its conception would be ideal; however, it is more unlikely to occur, so space reconfiguration can be an alternative solution (Panero & Zelnik, 1979).

Architectural Features

The architectural features of an environment include the physical aspects related to construction (building), which involves the distribution of doors, windows, beams,

and columns, all interfering in the manner that a space is arranged. This spatial arrangement could help or hinder workers' perception of comfort (Osborne, 1995).

Accordingly, comfort can be understood as the inter-relationship of three factors: interindividual variability, since individuals have different connections with the workplace, as well as tend to perceive and interpret differently the elements that compromise a context; the architectural features, as they bound people's adjustment with their environment; and finally, the individual activity, in order that people are constrained by task demands (Iida, 1992; Fraser, 1989).

A comfortable atmosphere incorporates concepts relating to physical, mental and cognitive demands and at the same time ensures satisfactory conditions that are necessary to carry out tasks. It is from such perspective that the literature emphasizes the need to define spaces that can be customized by the workers, where they could establish a parallel with their personal characteristics and, at the same time, respect interpersonal differences (Bridger, 1995; Macleod, 1995).

In this sense, the mobility of people, materials and equipment, the size of the work space, the electrical and

hydraulic installations, and architectural objects have a close relationship with environmental arrangements and should receive special attention, since they enable the connection between the subject and the physical environment (Fraser, 1989).

According to Panero and Zelnik, (1979) the appropriate size for a given physical space depends on the type of the activity performed. Each activity has specific requirements related to physical space characteristics. Thus, jobs have different necessities like some require more concentration, that is, more quiet and reserved spaces while other jobs demand more ventilation or large areas for equipments and materials.

When planning the size of a workplace it is important to take into consideration the availability of architectural space, which also should be associated with specific task requirements, furniture displacement, equipment, light sources and others that will compose a determined work area. If architectural space is not taken into consideration, it could be the case that employees are placed in unsuitable environment for months, years, even decades, since its redesign can be costly for both the

employee and the company (Iida, 1992; Pheasant & Haslegrave, 2006).

From this perspective, planning a workplace design or redesign involves integrating innumerable elements such as the worker's posture, body movements to perform certain tasks, proper heights, lighting and ventilation features, size of equipments, tools, and machines. Those characteristics, when completely or in part ignored, might result in an increase of workload, which leads to higher incidence of errors, productivity limitation, and stress (Fraser, 1989; Bridger, 1995).

Environment Factors

Environment factors are the conditions of the physical area, as lighting, temperature, noise, air quality, and vibration. These factors highly interfere with work performance and also can heavily impact both the company and the employee (Macleod, 1995). For the company, the effects are related to productivity, while in terms of workers, it is mainly related to their health and wellness (Iida, 1992; Pheasant, 1996).

Therefore, when designing and/or redesigning workplace layouts, the physical characteristics that provide thermal

comfort, ventilation, lighting, noise, and movement must be taken into account (Macleod, 1995).

Lighting. There are two types of lighting used in workplaces: the natural light and the artificial light. The artificial light allows for greater control results, so it is possible to control its quantity, type, and the placement of light sources for executing a particular task, whereas natural light is more limited, requiring a direct dependence on climatic conditions (Iida, 1992).

However, Bridger (1995) emphasizes the importance of submitting workers to natural light whenever possible, since the constant use of artificial lighting can cause health problems. In this sense, when addressing the lack of natural light, a chosen artificial light should present sunlight characteristics.

The type of artificial lighting used in workplaces will depend on the type of activity that is being performed. By improving lighting characteristics, enterprises can reduce their rework costs often times caused by glare.

According to Bridger (1995), glare occurs when a light source is located within the person's viewing angle, emitting an amount of light equal or greater than the amount needed for an object to be seen. Errors during

production process resulting from inappropriate product identification, usually caused by direct or indirect glare, is an example of this problem (Bridger, 1995).

The closer a light source is to the optical axis, the greater is the reduction in visual capacity. The symptoms of visual discomfort, such as tired eyes and difficulties in focusing on determined objects among workers are associated either with glare, type of lighting, and/or light incidence on screens (Karwowski, 2006).

Hence, environment illumination is considered as an important factor regarding working conditions. If well applied, it can contribute to improving productivity, reducing fatigue and accidents in the workplace (Iida, 1992; Schlick, 2009). In the kitchen workplace, it is recommended that the standard illumination should be 500 lux for food preparation and cooking; 300 lux for serving areas, food pre-preparation, and washing up areas; and 150 lux for storage places (Eagles, & Stedmon, 2004).

Noise. Noise is generally defined as a sound nuisance. Therefore, in a real working situation it is related to its function, that is, what for many people might be an inconvenience, for others may be an important source of information, extremely necessary to execute certain tasks

or as a cautionary feature (Sailor & Hassenzahl, 2000). At a kitchen workplace environment the oven timer buzzer might be a disturbing sound. At the same time, however, it is indispensable to remind cooks that a cycle of the oven has been completed, as well as to prevent accidents such as fires.

Intense noise can interfere in activities that demand concentration, attention, and speed, since they are significant disruption factors. Such interference can increase heart rating and breathing, blood pressure, peripheral vasoconstriction, cerebral vasodilatation, and adrenaline, which may reduce human performance and consequently can cause an increase in error incidents, and possible workplace accidents (Oborne, 1987; Sailor & Hassenzahl, 2000). The standard recommended noise level for the workplace environment should not exceed 85 dB (National Institute for Occupational Safety and Health, 1998).

Temperature. To maintain a constant body temperature, humans have internal mechanisms that thermo regulates the temperature of body within certain limits. Environmental temperature influences one's performance, for example, when an individual temperature decreases below normal levels, and s/he needs to produce much greater quantities of heat,

which results in higher energy consumption (Bridger, 1995; Salvendy, 1987).

Industry has developed innumerable artifacts to ensure comfortable levels of temperature and humidity in different environments as air-conditioning, heating, sunscreen, curtains, shutters, air humidifier, etc. The temperature of an environment may be adjusted from natural or artificial ventilation. When using natural ventilation, air renewal is promoted reducing energy expenditure (NIOSH, 1992).

When natural ventilation is not viable, the need of systems to control temperature is essential. However, artificial ventilation systems might cause disturbances as the need for constant maintenance, adequate cleaning, and energy costs (NIOSH, 1992).

Equipment and Human Dimensions

The series of procedures for measuring the various segment of the human body is defined as anthropometry. Over the years a lot of anthropometric data has been collected, but only in the 1940s it ceased to be used only in taxonomy and it became of importance also in ergonomics studies (Iida, 1992).

When designing the layout of an environment, dimensions of the human body need to be measured in two

ways: from static mode and dynamic situation. The first involves head, torso, and extremities performed in standard positions. The latter concerns measurements taken during work activities. Anthropometry is a complex concept, involving many factors, such as the variability of body dimensions associated with age, sex, ethnicity, and type of activity (Pheasant & Haslegrave, 2006; Schlick, 2009).

According to Bridger (1995), a new conception of workplace stands for developing comfortable environment to ensure both workers' health and their efficiency at work. Architects, designers, ergonomists and professionals from different fields rely on anthropometrical data for their projects. Some employers, however tend to give a simplistic character to anthropometric studies, often times because they see it as an unnecessary expense. Although the applicability of anthropometric data in layout designing aims first to provide comfort, it has no desire to meet 100% of the population characteristics, since high costs and complexity would make the project unachievable (Pheasant & Haslegrave, 2006) and thus more likely for employers not to apply it.

For that reason, extremes of a determined population are considered as reference and 5% of the lowest and

highest measurements are excluded. Consequently, 10% of the extreme measures are excluded, bringing the project to meet 90% of the population. This index is known as a confidence level, which is believed that, if properly applied during the design/redesign of furniture, equipments, and layout, it ensures efficiency at work and contributes to the health of employees (Panero & Zelnik, 1979).

The following are standard measures that should be taken into account when designing equipment for workers such as those who work in a kitchen environment: clearance of at least 24 inches for people and 50 to 53 inches when one has food service carts; work surfaces height must vary from 35 to 38 inches and work surface depth (light manual activity) should be in the range of 24 to 26 inches; the recommendation for women for storage of light objects is 72 inches maximum, heavy objects is 60 inches maximum and for objects used frequently is 45 inches (Panero & Zelnik, 1979; Schweitzer, 2010).

Work-related Musculoskeletal Disorders (WMSDs)

Work-related musculoskeletal disorders (WMSDs) are a phenomenon pertinent to work, characterized by the occurrence of various symptoms concomitant or not, that affect nerves, tendons, muscles and supporting structures.

The WMSDs is often the cause of temporary or permanent incapacity for work. This is due to the result of overusing the anatomical structures of the musculoskeletal system (Violante, Kilbom, & Armstrong, 2000).

The manifestations of WMSDs can vary from individual to individual, not all people have visible signs of disturbance, but some signs and symptoms are common to all. The first symptom is pain, which may begin with intermittent stabbing pain, often accompanied by muscle fatigue and discomfort. In this case recovery can take place by means of short rest periods. Thus, if distress factors are not eliminated, the pain that initially is mild or moderate and related to some determined movement becomes semi-continuous or continuous, severe, radiating and diffuse, with periods of exacerbation when executing certain movements at the end of the working day or even while out of work. One of the most frequent complaints at this stage is night pain which prevents one from sleeping and promotes significant psychic detritions (NIOSH, 1997).

In addition to pain (Kuorinka, 1995; NIOSH, 1997), other manifestations of WMSDs are subjective sensations of heaviness and tiredness in the affected limb, numbness, tingling, circulatory disorders, edema, flushing, sweating,

loss of muscle strength, shock, changes in sensitivity, emotional disorders, depression and insomnia. The main causal factors for the occurrence of WMSDs are:

- Organizational factors: heavy workload, overtime, double shifts, fast-paced work environment, insufficient rest breaks, etc.
- Biomechanical factors: excessive force, continual repetition of movements, fixed or constrained body positions, among others.
- Psychosocial factors: intense pressure to achieve high results, tense work environment, interpersonal relationship problems, overly strict work conditions, and so on.
- Working conditions factors: temperature, vibration, furniture, noise, lighting, space, tools and others.

To consider these factors to be crucial for the occurrence of WMSDs is important to analyze their intensity, duration, and frequency.

The complexity of Work-related musculoskeletal disorders phenomenon is due to the heterogeneity of clinical symptoms, the difficulty of diagnosis, socio-economic influences on the recognition as an occupational

disease, psychosocial effects, conflicts of interest, and treatment and rehabilitation difficulties (Violante, Kilbom, & Armstrong, 2000).

In an attempt to diagnose the causes of WMSDs, studies have been conducted with the purpose of correlate physical, organizational and psychosocial variables with the occurrence of the symptoms. Among a variety of methods, reporting of symptoms by workers has been the most widely used because it is faster and more economically viable (Kuorinka, 1995).

Intervention Model

This study adopted a qualitative research design utilizing the "Francophone Ergonomics Model", also called "Activity Oriented Ergonomics," which focuses on the work analysis aiming at evaluating real work situations that allows a reassessment of work demands. The Activity Oriented Ergonomics (AOE) design also enables the researcher to understand the real interrelationship between individuals and their activities at the workplace. As De Keyser mentioned, this model has been around for almost 50 years and throughout these years, it has developed its own concepts such as a "priority to field studies as opposed to laboratory research, development of very precise methods

for analyzing the behavior of human operator observed in real situations, and a broad consensus on models underlying the research" (as cited by Garrigou, Carballeda & Daniellou, 1994, p. 199).

The fundamental premise to make an evaluation based on the Francophone Ergonomics Model is the analysis of subjects' attitudes in real work situation (Ferreira & Mendes, 2003). The in-depth study of a job activity aims to propose improvements in existing working conditions. Therefore, one can consider this approach in ergonomics as a very meticulous process that evaluates events in a very short distance. It is important to say, however, that it does not have the ambition to describe global situations, but to devise the best solutions to problems promptly investigated. In this sense, intra- and interindividual variation of subjects and situations should always be taken into consideration during the different steps of the analysis of the activity (Ferreira & Mendes, 2003; Hoffman & Militello, 2009).

The AOE (Ferreira & Mendes, 2003) performs a microscopic view of the activity, showing its nuances, which is very appealing when considering health issues. However, usually the results do not have a generic

extension to analogous situations since it studies selected subjects in specific situations.

The intervention in AOE is a unique process that starts from a demand socially established. The contours and forms of the intervention itself are transformed when confronted with the real work situation, determining the sequence of steps and the outlines of reality (Ferreira & Mendes, 2003).

The AOE, with all its stages, first involves decomposing the activity aiming at a better understanding of it. With that, one can then reestablish this activity under a new basis, considering the analysis of actual work and having workers participation in the process (Ferreira & Mendes, 2003; Garrigou, Carballada & Daniellou, 1994).

CHAPTER III

METHODOLOGY

This chapter provides the methodological approach adopted in this research, with a description of objectives, participants, data collection, data analysis, and the procedures performed. The chosen intervention model for this study was the "Activity Oriented Ergonomics" (AOE), which relates to the study of the performed activity. One main characteristic of the AOE is the fact that it offers flexibility within the process; it also allows adaptability in accordance with the real work situation.

Participants

The study population consisted of 25 cooks currently working in six dining centers that were selected to participate in the research. The dining centers are located inside six different public elementary and middle schools in a city in the south of Brazil.

Due to a relatively small population, the researcher invited all employees to participate in the study. Participation was certainly voluntary, and all cooks agreed to participate in this research. The employees had full awareness of the purpose of the study, possible risks,

associated benefits, and data confidentiality regarding their participation in the project.

The main characteristics of the population consisted in all employees being female and working at a small dining center inside a public school. They did not have any knowledge in ergonomics, neither had had any safety training.

The researcher received approval to conduct the study by the University of Northern Iowa Institutional Review Board (IRB). The researcher and advisor completed a training regarding human research participant protection prior to data collection. The Institutional Review Board also requested copies of all materials, which includes forms, questionnaires, and consent letters, among others, for IRB approval. After approval was obtained, informed consent was acquired from the manager and each subject, enabling the researcher to start the data collection.

Materials

A questionnaire was utilized to survey the employees (see appendix A). The questionnaire designed for the manager contained questions related to the employees' daily activities, such as the duration of breaks, how many hours employees spend on any given activity, data on turnover, as well as health-related absences.

The questionnaire that was used to survey the employees was developed based on the Nordic Musculoskeletal Questionnaire (NMQ). The NMQ, developed from a project funded by the Nordic Council of Ministers as part of an ergonomics program, is one of the most widely used questionnaires to screen musculoskeletal-related disorders (Karwowski, 2006). Brief and simple, the NMQ is easy to administer. A general questionnaire divided into seven parts (personal details, musculoskeletal disorders, neck trouble, shoulder trouble, low back trouble, wrist or hand trouble and general information about one's job), the NMQ intends to draw a body map diagram of a given subject's pain both within the previous twelve months and in the past week. The questionnaire has been used in numerous studies; its reliability, therefore, has been tested (Kuorinka, Jonsson, Kilbom, Vinterberg, Biering-Sorensen, Andersson, & Jorgensen, 1987).

In addition, other four forms were used to record both dimensions and characteristics of workspace layout, equipment, and furniture as well as tasks and any awkward posture frequencies (see appendix B). Such forms were developed based on the "Ergonomic Design Guideline for Engineers, version 3.2.1", prepared exclusively for Deere &

Company by Humantech, Inc., and which was lent to the researcher for the sake of this thesis project. Humantech is the largest ergonomics consulting company in North America. The ergonomics tools provided by the Humantech have been applied to hundreds of corporations around the world, yielding evidence that such tools are reliable and effective (Humantech, 2007). Furthermore, two tools were used in addition to assessing working conditions ergonomically: NIOSH Lifting Equation and Carry Guidelines (see Appendix C), both of which are Microsoft Excel workbooks that were obtained from Deere & Company (also allowed by Deere for use in this project). These two tools were created by the National Institute for Occupational Safety and Health (NIOSH).

NIOSH is a United States federal agency created "to generate new knowledge in the field of occupational safety and health and to transfer that knowledge into practice for the betterment of workers" (Centers for Disease Control and Prevention). NIOSH administers research focusing on the prevention of work-related illness and injuries that are worldwide recognized. The agency not only helps workers in the United States; its tools are also widely utilized in Brazil where the data for this research was collected. In

Brazil, the NIOSH tools are accredited by the country's Ministry of Labor and Employment.

To assess environmental characteristics of the workplaces the researcher used a digital illuminance meter, a digital temperature thermometer, and a measure tape. In addition, a digital camera was used to take photos during the period of time that the participants were performing their tasks. The camera was also used to take photos of the work environment.

Data Collection

The first contact with manager of the kitchens was made by email. At that time, the purpose of the study was explained, the total length that would be necessary for data collection was discussed, as well as how and what kind of data would be collected.

The researcher personally went to each one of the six schools to explain the study to each group of cooks. For the convenience and discretion of the interviewees, the questionnaires were left in a box located at their break area. The cooks were free to ask any questions regarding the study throughout the entire processes of data collection. Furthermore, each questionnaire had attached

the researcher contact information in case of any additional questions and/or concerns.

The observation phase started by analyzing the workplace and also the employees performing their regular work activities. This part of the observation comprehended identifying and contextualizing the operational methods of individuals according to their work demands and different work case scenarios. Informal conversations were conducted with the cooks and the manager, the content of which stemmed entirely from the research question (described in Chapter I). Furthermore, cognitive abilities were also measured by the researcher during the observation process. This involved checking for skills such as time management abilities for daily planning process, knowledge about cooking techniques, hygiene awareness to avoid cross-contamination, as well as knowledge and capability to handle the equipment necessary to perform their everyday tasks.

Finally, the last observation stage was performed to evaluate the workplace environmental characteristics aiming at identifying levels of lighting, temperature, and humidity present in each kitchen. In addition, the researcher also analyzed tools, equipments, furniture, and

physical space. All information gathered during the observation processes was also used to fulfill the ergonomics criteria checklist forms (see Appendix B). At the end of the last day of data collection, the researcher gathered all 25 questionnaires from the designated drop-off location.

The total observation process length was seven days. The observation happened during a certain period of the workday, always starting before the dining center was open to the public. At this time, the researcher analyzed food preparation activities performed by the cooks. Then, when the dining center was open, the researcher observed the activities performed while the cooks were serving the food to the students. Finally, when the dining center was closed to the public, the researcher was able to analyze the way that cooks would perform activities related to cleaning and organizing the kitchen. Additionally, it was also at this time that the workplace layout, equipments, and furniture were particularly investigated. The observation process was accomplished in an average of four hours a day, which resulted in a total of 28 hours.

Data Analyses

In order to better answer the research questions, data was organized in different topics including characteristics of participants, workplace environmental conditions, biomechanics and anthropometrics aspects, as well as physical and cognitive demands. This structure was formulated based on the intervention model, aiming at clearly understanding the work organization in the kitchen environment and analyzing demand repercussions for worker's health and productivity.

The data collected from the Nordic Musculoskeletal Questionnaire (NMQ) was first processed using descriptive statistics (means, percentages, and standard deviation), which were calculated through the Microsoft Excel program. The results were used to evaluate the prevalence of pain in determined areas of the body of the participants and the physical demands faced by the sample of cooks in the study. The researcher added to the NMQ some complementary questions to accommodate demographic information and some individuals' personal characteristics, which included age, gender, weight, height, physical exercise practice, among others.

Furthermore, the information derived from the ergonomics criteria checklist forms was primarily employed with the purpose of analyzing working conditions. The gathered data was narrowed down to obtain information that would help to assess workplace environmental conditions as well as tool, equipments and furniture. Accordingly, the NIOSH Lifting and Carrying Guidelines Microsoft Excel workbooks (see Appendix C) were used to verify if some of the cooks' work activities were in line with the recommended safe specifications indicated by the National Institute for Occupational Safety and Health (NIOSH).

Summary of Methods

This study adopted a qualitative research design and followed the "Francophone Ergonomics Model" as guidance for evaluating the employees that were currently working at the dining center kitchen environment.

Participation in the study was voluntary, and all 25 employees agreed to participate. The researcher explained to all participants the purpose of the study along with its risks, benefits and data confidentiality.

The researcher made used of different means to conduct the data collection process which included evaluating tools, forms, and questionnaires, as well as tasks and workplace

analytical observation. These instruments were encompassed as valid and reliable taking into consideration the previous results of several different worldwide scientific studies in which those instruments were administered.

In addition, data collection involved systematic observation of the workplace and workers performing their functions focusing in analyzing individuals' operational behavior related to their work requirements.

Finally, in order to properly obtain the answers for the research questions, all data was analyzed and then structured based on the chosen intervention model. In this sense, the data results were grouped into distinct categories that were essential to the purpose of comprehend and clearly delineate the work organization framework that was in question in this study.

CHAPTER IV

FINDINGS

This chapter has the purpose of presenting all the data collected in the course of the research. In order to answer the research questions in an effective manner, data was organized in different topics including characteristics of participants, workplace environmental conditions, and task analysis, which includes physical and cognitive demands. This structure was formulated based on the intervention model, aiming to clearly understand the work organization in the kitchen environment and to analyze demand repercussions for workers' health and productivity.

All the data gathered using the researcher adapted version of the Nordic Musculoskeletal Questionnaire (NMQ) was used to develop the characteristics of participants and the task analysis topics. The checklist forms on Ergonomics criteria data were used to analyze the topics of environmental conditions and task analysis. Lastly, the NIOSH Lifting and Carrying Guidelines were employed only in the task analysis topic in order to evaluate activities of the cooks. Although these tools were essential for the project, the most important aspect of this research was the

analytical observation carried out in the kitchens that were observed.

Participants

The study population consisted of 25 cooks currently working in six dining centers that were selected to participate in the research. The dining centers were located in six different public elementary and middle schools in a city in the south of Brazil.

Although the study population consisted of 25 cooks, only four cooks participated in an in-depth study observation. The researcher, with the help of the nutritionist responsible for the management of the dining centers, selected one of the kitchens to conduct a detailed work/activity analyses and workplace environment evaluation. The selection was made based on the fact that the chosen kitchen was the one that had the highest demand when compared to the other units, serving an average of 950 meals daily (in two different shifts, since the school had two different class periods -morning and afternoon).

The schools kitchens ran by a third party company had a policy of selection and recruitment of staff defined by the central office. Such selection was done with the assistance of the local unit manager, who was also the

nutritionist for that given kitchen. The local unit manager makes the pre-selection of candidates, taking into consideration criteria such as education, work experience, and the distance between the candidate's home and the location of workplace. After this first step, the selected candidates were invited to take a test in a determined dining center kitchen. The test with the candidates analyzed capabilities such as agility, organization, hygiene, and politeness. Finally, the pre-selected candidates were sent to the human resources department, where the hiring process would continue, including additional steps such as psychological tests and medical examinations. After approval from the human resources, the candidate was hired and started an informal training with the manager/nutritionist and other cooks in the local kitchen.

The cooks in the population that this study encompasses had the following average characteristics: their age ranged from 20 to 59 years, with an average age of 41 years; they weighed an average of 154.5 pounds and were 5 feet 3 inches tall.

Table 1

Cooks' Characteristics (average)

Age (years)	Weight (pounds)	Height (feet)
41	154.5	5.3
Std Dev (σ)	Std Dev (σ)	Std Dev (σ)
9.7	10.4	0.1
Age Range	Weight (kilos)	Height (meters)
20 to 59	70.1	1.6

According to an analysis of the body mass index (BMI) of the participants, the researcher concluded that the majority of the cooks were overweight. More specifically, one cook was underweight, seven had a normal BMI, 10 were overweight and seven were obese. In addition, 17 of the participants reported they did not currently engage in any physical activity. As opposed to that, eight of the participants affirmed they exercised regularly. Accordingly, six of the cooks walked and two cooks rode a bicycle three or more times per week, for at least 30 minutes each time.

Table 2

Cooks' Body Mass Index (n=25)

Index	n	Percentage
Underweight	1	4%
Normal	7	28%
Overweight	10	40%
Obese	7	28%

The cooks' workday lasted 8 hours and 48 minutes in accordance with the Brazilian legislation. They also had an hour of nonpaid lunch break. Despite not having an official break time, cooks assured they took an average of 10 minutes of break twice a day on the majority of the days. All the participants declared that this was the only exclusively paid job they had with an average of two-and-a-half years of work experience at the present kitchen.

In what concerns physical issues of employees at work, the table below presents the results on the presence of self-reported problems such as pain, discomfort and/or numbness on designated body parts, considering the last 12 months. Given the number of participants, the results were displayed showing the exact number of cooks' complaints in each body area.

Table 3

Cooks' report of frequency of body pain, numbness, tingling or discomfort (n=25)

Body Part	Frequency			
	None	Hardly ever	Frequently	Always
Neck	14	4	5	2
Shoulder	14	8	1	2
Arm	11	9	3	2
Elbow	21	2	1	1
Forearm	13	7	4	1
Wrists/Hands/Fingers	14	4	4	3
Upper Back	13	7	2	3
Lower Back	10	7	5	3
Hips/Thighs/Buttocks	18	3	2	2
Knee	14	6	3	2
Leg	8	7	6	4
Foot	9	5	8	3

The survey showed more incidences of problems in four of the body areas, more specifically foot, leg, lower back, and neck. Eight cooks affirmed to have pain/discomfort frequently on their feet and three mentioned to have this same problem constantly. The leg region was identified by six cooks as the area where they feel pain/discomfort

frequently. Three of the cooks identified the same region as they feel pain/discomfort constantly. Furthermore, the lower back area was mentioned by five cooks as the region where they feel pain/discomfort frequently and three cooks affirmed to feel pain/discomfort constantly in this same area. Finally, five cooks reported to have pain/discomfort frequently on their neck. Two of the cooks identified the same area as they feel pain/discomfort constantly.

Accordingly, when participants were questioned about which symptoms they considered related to the job they perform, 56% (14) indicated the leg area, 52% (13) referred to the foot area, and 48% (12) reported back area.

Table 4

Cooks' report of frequency of body pain, numbness, tingling or discomfort related to work (n=25)

Body Part	N	Percentage
None	3	12%
Neck	3	12%
Shoulder	5	20%
Arm	8	32%
Elbow	2	8%
Forearm	4	16%
Wrists/Hands/Fingers	7	28%
Upper Back	6	24%
Lower Back	6	24%
Hips/Buttocks	0	0%
Thigh	1	4%
Knee	3	12%
Leg	14	56%
Foot	13	52%

In general, cooks reported physical fatigue after working hours. However, all of them declared they perform some kind of household chores such as cleaning, laundry, ironing, dish washing, etc. every day at home after work. According to workers medical reports, two of them had been diagnosed with arthritis, two had spinal disc herniation, and two had been diagnosed with repetitive strain injury

(RSI). Periodic health exams were conducted once a year by a certified occupational health physician to check their overall health. The Ministry of Occupational Health of Brazil requires that employers sponsor the health exams. The kitchen employees involved in this study reported that the company fulfills such obligation.

There were not any occupational accidents during the period that the research was being conducted. However, there were previous records of chemical accidents, burns, and cuts. All accidents were reported to the central office of the dinning centers, which takes appropriate action. According to the records, an accident occurs on average every six months.

Absenteeism was regular between the kitchen employees involved in the study, and there was a considerably high turnover rate in all dining centers. Employees report that they were usually absent at work because either they were sick or a family member was sick. High turnover occurred because the city where the dining centers were located is an industrial city with a large population and several school and factory kitchens. Employees have many options to choose from in terms of where to work, and they constantly

receive new job offers, often times paying a little more than they currently make as cooks.

Workplace Environment

The analysis of the workplace environment condition put emphasis in two main topics: layout characteristics of the workplace area such as physical space and equipment aspects; and ambiance conditions, which includes aspects of temperature/humidity, luminosity, and noise.

Layout Characteristics

There were essentially four activities that were performed in the kitchen space, which were food preparation, cooking, meal distribution, and cleaning/sanitation.



Figure 1. Layout characteristics of the studied kitchen

The area was composed by white base cabinets with granite countertops. The base cabinets had both doors and drawers. Above the base cabinets there were white open shelving units. Some of these units, however, were placed too high, making it impossible to reach without a step stool. In many of the kitchens, however, the cooks did not have access to the step stool and just used a regular chair, which caused serious liability problems for the employer (cooks might fall off the chair when trying to reach for items in the higher shelves and injure themselves). In

addition to that, there were two mid-size tall cabinets for extra storage. Both cabinets and shelves were mostly used to store dishes, utensils, and silverware, with the exception of the sink units that were used to store some cleaning supplies. There were two mobile work tables for extra counter space. The space was also equipped with the following appliances:

- Commercial six-burner stove;
- Domestic four-burner stove;
- Commercial oven;
- Domestic toaster oven;
- Domestic microwave oven;
- Commercial range hood;
- Water purifier unit;
- Refrigerator;
- Freezer;
- Commercial blender;
- Commercial food grinder;
- Commercial vegetable chopper;
- Commercial stand mixer;
- Commercial orange juicer;
- Domestic coffee maker;
- Six-station buffet server.



Figure 2. Layout characteristics of the studied kitchen

The studied kitchen had a total area of 344 square feet and the storage room that was attached to the kitchen had a total area of 115.8 square feet. The kitchen walls were floor to ceiling white ceramic tiles with an anti-slip ceramic tile on the floor surface. In the storage room the same anti-slip ceramic tile was used but the walls were painted with a washable/scrubbable paint instead. The kitchen had two doors, one that gives access to the kitchen itself from the school hallway and another that leads to the storage room. Light and ventilation was provided by

windows on one of the kitchen walls (the wall to the outside).

The storage room had four open shelving units that were used to store nonperishable foods, as well as an enclosed cabinet to store cleaning supplies. The open shelving units were designed to allow enough space for large containers to be stored on the floor, more specifically under the shelving units (properly identified with tags, as seen in the picture below).



Figure 3. Storage room shelving and supplies organization

Ambiance Conditions

Temperature and humidity. The thermal conditions were noted by excess of moisture and heat even in cold weather, since the average winter temperature in the city where the kitchen was situated is 66.5 degrees Fahrenheit. The city atmospheric conditions are super humid, mesothermal, with short periods of aridity. The annual relative humidity of air in the city is considerable high with an average of 76.04% (Institute of Research and Planning for the Sustainable Development of the City, 2010/2011).

Cooking was by far the activity that most negatively affects the thermal condition in the kitchen due to the heat radiation and steam that was produced from this type of task. Equipment such as oven and stove were the main contributors to the cooks' discomfort. The availability of a commercial range hood in the kitchen was very favorable to assisting in the extraction of escaping steam, but the limited number and distribution of windows holds down the ventilation of the room.

Lighting. The kitchen had satisfactory luminosity with a combination of natural and artificial light (over 500 lux). Cooks reported some sporadic glare from light sources in the afternoon. This fact was due to sunlight coming

through the windows and reflecting on the metal surface of the equipment, causing unfavorable luminance contrast.

Noise. Constant noise presented in the kitchen originated from the range hood; other occasional noise came from equipment used for a short period of time, such as vegetable chopper, blender, mixer, oven buzzer, voices and collision of metal utensils. Sound levels in the kitchen were measured during a regular work day where full meals were being prepared. The sound levels varied between 58 dB to 77 dB, which is well under the recommended level of 85 dB maximum. All four cooks working at the researched kitchen stated that they got used to the range hood noise but they noticed a good pleasant difference in the noise level when they turned it off.

Task Analysis

The studied kitchen presented a total of four cooks. Cooks were allocated to different sections according to production needs during the food preparation period. The division of tasks and the number of cooks allocated by section was determined by the menu of the day.

The monthly menu was elaborated by the nutritionist and organized as follows: in a given week, a full meal (e.g., entrée, side dish, and salad) would be served two

days per week and a light meal (e.g., sandwich and fruit juice) would be offered in the other three days. The following week, the reverse would occur, i.e., a full meal would be served three days per week and a light meal would be served two days per week. See a sample of a monthly menu in Appendix D. The nutritionist also provided a recipe and instruction handbook containing guidance on food handling, preparation, and recipes to be used by the cooks on a daily basis. The handbook was updated by the nutritionist as needed and additional everyday cooking and hygiene instructions were affixed on the kitchen walls.

There were five distinct sections that were part of the kitchen daily work activities: storage of commodities, food pre-preparation, cooking, meal distribution, and sanitation. These activities were well connected to each other, and the cooks themselves decide who would do each of the activities based on task complexity and individual affinity.

Storage of Commodities

This section was intended for storage of perishable and non-perishable food items and cleaning supply. The food was delivered periodically once a week following the monthly menu with the exception of bread loafs and buns

that were delivered at the day of consumption to guarantee product freshness. Cleaning supplies were delivered once a month or as needed.

Perishable items were stored in the freezer or in the refrigerator, both of which were located in the kitchen main area. The non-perishable items were stored on open shelving units located in the storage room area. Fruits and vegetables that need soon be consumed were stored in large containers that were placed on the floor under the open shelving units in the storage room. The room also accommodated an enclosed cabinet that was used to store cleaning supplies.

There was not a pre-designated worker that was responsible to receive, store and organize food items. Items were delivered by one or two deliverymen who stacked the food close to the storage location. The items were then organized and distributed to their specific place by the cooks. The number of cooks performing this task would vary from one to two depending on how busy they were during that specific day.

All shelving units and cabinets were labeled with identification tags to indicate where items should be placed, which was a very important detail regarding

cognitive aspects. The shelves height followed recommendation, which is 72 inches for light weight products and 60 inches for heavy weight products (Tilley & Dreyfuss, 2001). However, when considering the height of the top shelf adding the dimensions of the commodity stored in it, the height increases from 12 inches to as high as 98 inches, making it difficult to reach and increasing the chances that items would fall off the shelf. According to NIOSH, heavy weight items are those which weight ranges from 51 to 70 pounds.

The storage room had limited space for storage and the circulation of people. It was observed that prior to organizing, most of the commodities were stacked on the floor, increasing the risk of shock and falls. To perform tasks in this section, the posture of cooks varied between standing and sitting. Weight lifting by the cooks was done incorrectly using awkward posture such as bending over repeatedly and twisting the body during lifting. Cooks reported that they sometimes used a chair to help in some of the chores but most of the time they were too busy to reach out for it, so they did it anyway they could. In addition to physical demands to perform tasks in this

section, cooks needed to have some cognitive abilities like time management and organization skills.

Food Pre-Preparation

This section was designed to the pre-preparation of food which included activities such as sanitizing, peeling and chopping of greens, herbs, vegetable, fruits, and the preparation of meat, fish, and poultry. Cooks in this section were also responsible for assisting in the food portioning, thus making the process of meal distribution more efficient.



Figure 4. Food pre-preparation section

The physical space was satisfactory to perform all tasks required by the food preparation section, even in times of higher demand. It was observed that the activities carried out in this section involved the work of one to two cooks, depending on the menu of the day. The circulation space, as well as the operation work area available for this section was sufficient for the execution of all activities with proper horizontal reach. It was also noticed that there was enough clearance for legs and feet at the lower part and bottom of the workstation.



Figure 5. Food pre-preparation auxiliary equipment

On the other hand, repetitive movements were constantly observed during chopping and peeling activities. Cooks' postures were static standing and facing the working surface with neck, and at times torso, bended for long periods of time. Furthermore, cooks reported some discomfort related to humidity when cooking was being performed. The humidity from cooking also lead to wet floors, and although the floor was a non-slip ceramic tile, with the excess of moisture it became slippery, increasing the chances of accidents.

It was found that cooks reduced or accelerated the speed when performing the activities according to the menu and food consumption. This way, they were able to relocate when necessary to other sections to balance out the total work demand. The cooks had access to mobile work tables, which gave them flexibility to move around the kitchen with ease according to their needs without affecting the quality of their work. In addition to physical demands, this activity also required cognitive applications such as hygiene awareness to avoid cross-contamination, as well as time management and organizational skills.

Cooking

This section was intended for all cooking and baking activities performed in the kitchen. The majority of the cooking activities were performed two to three times per week when full meals were prepared. In the remaining days cooking and baking took place more occasionally to prepare some items listed in the light meal menu such as puddings, omelets, and sweet breads. Usually two cooks were designated to perform tasks in this section. The physical space for this area was sufficient to perform all activities required giving the cooks ability to move around comfortably. In addition, they had enough clearance for legs and feet as well as satisfactory horizontal reach.



Figure 6. Cooking section

Cooks performed their duties while standing mostly with neck bended and occasionally twisting the torso and engaging in repetitive motion. Despite the existence of kitchen exhaust system and windows, the heat was evident in the environment, taking into account that the observation occurred in the spring season. Excess of moisture in the kitchen was aggravated by this section considering the concentration of equipment that generated heat and humidity. According to cooks' reporting, there were days that they had to dry the floor during the work shift as a result of excessive moisture. The noise from the range hood was

rather uncomfortable making communication difficult. It is important to mention that deep fried foods was not part of the diet offered to the students at any time, which required from cooks less effort regarding thermal conditions and safe hazards (such as burning accidents).



Figure 7. Cooking section

The activities in the cooking area involved both physical and cognitive demands. In addition to physical effort to perform tasks, it was necessary that cooks had cognitive competencies such as time management skills for daily planning process, knowledge about cooking techniques,

hygiene awareness to avoid cross-contamination, as well as knowledge and skill to handle the equipment necessary to perform their chores. Cooking activities were considered a priority, thus work flow was balanced to accommodate the demand. On days when full meals were schedule, cooking activities were accelerated.

Meal Distribution



Figure 8. Meal distribution section

This section was designated for the distribution of meals involving the work of two to three cooks that served the meals through a pass-through window located in the kitchen area. Cooks used a mobile buffet server to assist when full meals were being offered, and a mobile work table for extra counter space. Students waited in line to be served in the order that they arrived (on a first-come, first-served basis). Meals were distributed for a period of fifteen minutes. After students finished eating they were requested to place the silverware and dishes inside large containers designated to accommodate used silverware, plates, bowls, cups and glasses. Cooks would then collect those containers and bring them back to the kitchen so that dishes and silverware along with the containers could be sanitized.



Figure 9. Meal distribution section

The physical space in this area was very restricted considering space for cooks' chores and circulation with inappropriate horizontal reach conditions. This issue became worse when there was a need to allocate a third cook to help with the work in the section. Throughout the distribution period, cooks remained standing. Most of the time cooks engaged in repetitive movements and twisting of the torso, and frequently their head and torso were bended. Steam derived from the food contributed to higher levels of humidity and heat.

Cooks used different methods to serve the food. For instance, one way of doing it was to fill a plate with food directly from pots and pans or buffet server without portioning it first. The same happened with beverages, when the cooks served drinks from a large container directly into the students' mugs. Activities performed in this section were primarily physical, thus requiring some cognitive applications such as knowledge of how to use the mobile buffet server and ability to interact with the students.



Figure 10. Meal distribution section

Sanitize/Hygiene

This section was designated to cleaning and sanitizing of the kitchen, equipment, dishes, utensils, and silverware. Due to the facts that tasks in this section required considerable physical effort and the workload was high, there was a need to have two to four cooks working in this section. The physical space was adequate for performing all activities related to this section. The process of sanitation of items such as cookware, dishware, flatware, utensils, and containers involved pre-cleaning to remove food that remained in these objects and then only after they were washed, dried and stored. All these processes were done manually. The kitchen was not equipped with a dishwasher, which made the job very time-consuming and repetitive.



Figure 11. Sanitize/Hygiene section

Cooks designated do the dish sanitizing work remained in standing static position with the neck inclined doing constantly repetitive movements for a good amount of time. They sporadically moved around to transport some items to the sink area. The conditions for sanitation of large items were extremely inappropriate due to the fact that the sinks were too small and too shallow to accommodate most of their commercial-size cookware, as well as large containers. In this situation, cooks had to work most of the time with their arms above shoulder level.

Cooks responsible for drying and organizing sanitized items also had to remain standing doing repetitive movements, as well as rotating their torso and often times bending over.

Furthermore, cooks also cleaned and washed all equipment that had been used, like appliances and mobile work tables. Finally, they cleaned all the kitchen's surfaces, including the floor and some of the walls. All cooks were engaged in some sporadic cleaning activities throughout the entire day. The speed of work activities of the section was determined by the amount of items that needed to be sanitized. Cooks reported that every so often, at the end of the workday, they tended to work in a faster speed to be able to finish the work on time. Although activities in this section were mainly physical, it also required cognitive applications such as knowledge of proper sanitizing and adequate use of cleaning supplies, as well as time management and organization skills.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This final chapter presents a summary of the study and some recommendations. It presents some final remarks and recommendations on how to improve the working conditions and the quality of everyday life for the employees working at the kitchens involved in the study. Moreover, the chapter presents ideas for how to aid employees in gaining a better understanding of aspects of ergonomics for everyday work activities, as well as awareness of issues related to ergonomics. This chapter is divided into four parts: summary, conclusion, future research, and final comments.

Summary

The problem which the present study addressed was to detect issues that can be harmful to workers health regarding ergonomics criteria in the kitchen workplace environment. Although many ergonomics studies have evaluated workplace conditions, particularly office areas, very few studies have evaluated kitchens sites. Accordingly, the purpose of this study was to evaluate the workplace demands faced by a group of kitchen staff at six dining

centers, as well as to survey musculoskeletal complaints among this sample of workers.

The word Ergonomics descended from the Greek terminologies *érgon*, which means task, and *nomos*, meaning law or principle. The concept was created by Polish scientist Wojciech Jastrzebowski in 1857. However, it was not until 1949, when the Ergonomics Research Society was created in England, that ergonomics became the term used in the industrialized world. Ergonomics is an area of knowledge that aims to adapt the workplace to best fit people's characteristics with their job duties. In this sense, it is a field of study that intends to restore the workplace for the sake of the individual (Oborne, 1987).

Consequently, when applying ergonomics it is essential to know what workers actually do, how they do it, and why they do it in a determined way. Ergonomics thus focuses on analyzing activities that take place at real work situations. It requires investigation according to its principles in order to adjust the work to the human being. The activity that a person performs within his/her work environment comprises a constant process to build mediation strategies.

A topic that has been given attention in ergonomics research concerns the phenomenon of work-related musculoskeletal disorders (WMSDs). WMSDs are a complex condition which ultimately derives from a number of work components that act in a combined way. The WMSDs is often the cause of temporary or permanent incapacity for work. This is due to the result of overusing the anatomical structures of the musculoskeletal system (Violante, Kilbom, & Armstrong, 2000). Furthermore, work related musculoskeletal disorders have been a primary cause of morbidity in the restaurant industry, which greatly affects work effectiveness, productivity, and satisfaction. Thus, it is also considered by specialists to be the main reason for work-related sickness absence (Dempsey & Filiaggi, 2006).

The present study was developed following qualitative research design, and the researcher made use of the "Activity Oriented Ergonomics" methodology. "Activity Oriented Ergonomics" (AOE) focuses on the work analysis that evaluates real work situations that allows a reassessment of work demands. The AOE performs a minute view of the activity, showing its nuances, which is very appealing when considering health issues (Ferreira & Mendes,

2003). However, the results usually do not have a generic extension to analogous situations since it studies selected subjects in specific situations.

One of the study limitations was the fact that only 25 cooks from six sites were surveyed, when there are hundreds of schools in the city where these six schools are placed. Furthermore, only four cooks from one of these six dining centers participated in an in-depth study observation. The dining centers were located in six different public elementary and middle schools in a city in the south of Brazil. Participation in the study was voluntary, and all 25 employees agreed to participate. The researcher explained to all participants the purpose of the study along with its risks, benefits and data confidentiality.

The researcher made use of different means to conduct the data collection process which included workplace analytical observation, tasks observation, informal conversation with cooks and manager, as well as evaluating tools, forms, and questionnaires. Thus, the observation of the workplace and workers performing their functions focused in analyzing individuals' operational behavior related to their work requirements.

Data was organized in three different topics including characteristics of participants, workplace environmental conditions, and task analysis, which contains physical and cognitive demands. The analysis of the workplace environment condition emphasized two main topics: layout characteristics of the workplace area such as physical space and equipment aspects; and ambiance conditions, which comprises aspects of temperature/humidity, luminosity, and noise. There were essentially four activities that were performed in the workplace, which were food pre-preparation, cooking, meal distribution, and cleaning/sanitation.

Finally, the same line of organization that was found on chapter IV was kept in chapter V where recommendations were made in order to improve the working conditions of the staff as well as their knowledge and awareness regarding everyday aspects of ergonomics.

Conclusion

The development of this research enabled the identification of factors that relates the influence of working conditions on the health status of cooks from the studied kitchen.

Analysis of Environmental Conditions

In general, the physical space in the kitchen was satisfactory, however in the storage and meal distribution areas, it was observed that problems regarding limited space for circulation of people and working activities existed. In the storage room area, space issues occurred during delivery days when the clearance allowed for circulation of people varied between 20.8 and 51.5 inches. Therefore, noticing that the recommended clearance is at least 24 inches for people and 50 to 53 inches when one has food service carts (Schweitzer, 2010). The same space issues were observed at the meal distribution area where at some days clearance allowed for circulation of people measured was as little as 18 inches. It is also important to point out that cooks did not have any food service carts which made carrying activities much more difficult and arduous to be accomplished.

The kitchen countertops were 35.6 inches height and 24.8 inches deep, which were well within recommended, since work surfaces height must vary from 35 to 38 inches and work surface depth (light manual activity) should be in the range of 24 to 26 inches (Panero & Zelnik, 1979). The cooks' average reaching height ranged between 47 and 75 inches,

and the maximum reaching height for storing items was 100 inches in the storage room. Considering that the recommendation for women for storage of light objects is 72 inches maximum, heavy objects (51 to 70 pounds) is 60 inches maximum and for objects used frequently is 45 inches, it was asserted that items stored at the top shelf units in the storage room and in the kitchen itself required additional physical effort by the cooks, increasing the risk of falling objects and accidents (Schweitzer, 2010).

Constant thermal discomfort experienced by cooks in the kitchen area, more specifically a combination of climate conditions and physical circumstances generated by cooking equipment, made their work more difficult to do, negatively affecting their performance. In addition, this uncomfortable condition also contributed to increasing the cooks' physical demands by the fact that they needed to dry the floor and occasionally walls surfaces due to the excess of moisture.

Noise levels in the kitchen were within the standards set by Brazilian work legislation (Brazil Ministry of Labour, 1999). However, the continual noise coming from the hood range made the communication between the cooks very difficult. This problem was aggravated especially when

blender and mixer equipment were being used at the same time, requiring cooks to stop their current activities and walk to other sections of the kitchen in order to get clear information from colleagues.

Analysis of Physical Conditions

Most tasks performed by the cooks required considerable physical effort, from moderate activities to heavy-duty chores. Although it requires cooks such physical effort, it was found that the majority of the cooks were overweight (by analysis of their body mass index). More specifically, 40% of the cooks were overweight and 28% were obese. Weight excess can contribute to making the job more stressful, since the extra weight adds to overloading of the spinal column, which is a major factor in the development of back and neck pain (Fraser, 1989). In addition, all the cooks who participated in this research were women, and according to studies abdominal obesity increases the risk of developing breast and uterine cancers (Ballard-Barbash & Swanson, 1996).

A major aspect observed was the fact that most of the activities performed by the cooks were done in a standing still position. Some of the tasks required cooks to walk around but very few of them would enable cooks to sit down.

Another important factor observed was the repetitive motion situation, which in most cases forced cooks to adopt uncomfortable postures, requiring the neck, head and torso to remain bent over for long periods of time. OSHA (Occupational Safety and Health Administration, 2004) warns that in the long term these awkward postures and movements can affect negatively the general health of these operators. Improperly weight lifting was also noticed in the observation, which can be related to cooks' lack of information, both regarding the proper way to handle loads and in the health problems consequences that incorrect execution of these acts may imply in the future. In addition, aspects such as hurry and lack of patience would make cooks engage in improper postures. In this study, all cooks reported that they feel tired at the end of the work day, which suggested a high work demand.

Through the variety of aspects studied in this research, it was revealed that even with the availability of equipment and days where a light meal was offered, the series of activities performed by the cooks were still quite strenuous. These activities can be characterized by repetitive hand motion, sporadic but incorrectly weight-lifting, and standing postures for extended periods of time.

It is emphasized in the literature that the constant practice of activities such as those described above can cause health problems. According to the literature work-related musculoskeletal disorders (MSDs) are more likely to occur in operators engaged in such activities. Finally, it is important to mention that taking actions to change those situations to prevent health problems reduces the risk of accidents and can generate higher productivity (NIOSH, 1997; Kuorinka, 1995).

Analysis of Cognitive and Organizational Conditions

Cooks had the skill to perform the majority of the cognitive aspects required by the assigned tasks, even in the absence of the nutritionist. They often had at hand the instructions/recipe book and also followed the basic instructions that were affixed on the walls.

At the end of the workday the job was accomplished, even when they had a busy day. Procedures required for the execution of tasks were many times performed by the workers with the only objective of getting the job done, not taking into account their health and well-being. Some cooks reported work overload, caused by the limited number of employees. During the observation stage, cooks' time of entry and exit were always done accurately, while the time

for their meals varied according to the rhythm of daily activities.

Despite the various physical, environmental, and wage issues, cooks showed some satisfaction to work on the site. It is believed that this was due mainly to the organizational conditions, especially the fact that cooks had relative autonomy in performing their duties. In addition, another factor related to satisfaction reported by the cooks was their good relationship with the nutritionist, who allowed them to contribute with the decision-making process most of the time. Moreover, cooks reported they were very satisfied by the fact that they could eat anytime throughout the workday, more specifically between the meal break established by the nutritionist.

Recommendations

The central objective of this ergonomics intervention was the transformation of the work situation that was studied. Thus, from the ergonomics analysis of the workplace, real work situations were evaluated allowing a reassessment of work demands.

More importantly, through the integration of ergonomics and work activities, as well as the improvement

of the cooks' health and work conditions, recommendations were developed as follows.

Environmental Characteristics

- Removal of the meals distribution section from the kitchen area to the dining area, providing enough space for cooks tasks, circulation, and equipment;
- Restructure the physical space for the storage room, providing enough space for food delivery, circulation of people, and utility carts. A clearance of at least 50 inches is required to allow the transit of utility carts for an easy food loading and transportation;
- Maximum height of storage must not exceeding 60 inches for heavy items and 72 inches for light items;
- Reassessment of the exhaust system and ventilation in order to minimize the thermal discomfort in the kitchen;

Physical and Gestural Characteristics

- Rotation of cooks activities to prevent the execution of repetitive tasks for long periods of time in the areas of pre-preparation, cooking, meal distribution, and sanitize/hygiene;

- Adoption of small breaks routine throughout the workday in order to minimize fatigue.
- Acquisition of a commercial dishwasher to prevent cooks from engaging in repetitive motion activities, thus avoiding unnecessary physical efforts and allowing better productivity;
- Addition of a commercial deep sink or utility tub to assist in the activities of cleaning large items such as pots, pans, and containers, which would preventing cooks from awkward postures.
- Acquisition of utility carts to prevent cooks to carry heavy weight items and stacks.
- Addition of proper step stools for easy reach of high surfaces.
- Addition of adjusting work benches in order to minimize the individual differences of cooks and avoid extra physical effort and awkward postures;
- Acquisition of work stool, seat-stand stool, and foot rest to promote comfort. Stools will prevent cooks from staying in the standing posture for long periods of time.

- Stimulation for cooks to frequently consume small amounts of cold water, especially during summer, to minimize the effects of thermal discomfort;
- Implementation of a Labor Gymnastics Program aiming at preventing diseases caused by cumulative trauma injuries, prevent muscle fatigue, correction of poor posture, increasing the willingness of cooks to start and return to work, reduce the number of accidents, and promote greater integration in the workplace environment. The Labor Gymnastics Program plays an important role in the control of occupational diseases, however it mostly will not have the desired effect if it is seen as the only form of intervention (Polito & Bergamaschi, 2002).
- Addition of window treatment to minimize glare caused by sunlight;
- Periodical inspection of the lighting system, preventing the occurrence of dead light bulbs in the workplace environment;

Cognitive Characteristics

- Organization of more frequently-used items versus items less used by cooks to assist in efficiency.

- Addition of tags in the kitchen area to identify the location of items.
- Implementation of an Ergonomics Training Program custom designed for cooks that includes modules about basic ergonomics, adoption of correct postures and gestures to perform tasks, proper use of tools and equipment, identification of hazardous conditions, and the consequences of bad postures in the long term.
- Addition of basic ergonomics instructions on the kitchen walls.
- Stimulation for cooks to submit questions and concerns to their manager;
- Development of a Nutrition Program Training designed especially for the cooks including modules on basic nutrition, healthy eating habits, daily energy intake, and the consequences of unbalanced food consumption over the long term.

In this sense, the acquisition of knowledge in ergonomics and nutrition will reflect positively on cooks' health, benefiting employees and the company in general.

Future Research

- Training materials such as Ergonomics Guidelines;

- An in-depth study regarding layout arrangements aiming at cooks well-being and productivity.
- Studying the correlation between cooks' weight and the prevalence of pain in determined areas of their bodies. In addition, validity and reliability test may also be conduct.
- Studying the correlation between high-temperature environment and employees' productivity.
- The application of this methodology in the remaining public schools in the city;
- The application of this methodology in the private schools in the city (for comparison purposes);
- Conducting a longitudinal study, to allow a more global view of the ergonomics situation of cooks from the food service industry.

Final Comments

The development of this research enabled the identification of factors that affect cooks well-being in conjunction with their efficiency and effectiveness when performing their tasks.

- The work carried out at the dining center requires physical efforts, repetitive movements for long

periods, sporadic loading and lifting weights, standing postures for a long period of time, and awkward postures during the performance of activities;

- Cooks presented musculoskeletal illness symptoms more frequently in the foot, leg, lower back, and neck;
- The Activity Oriented Ergonomics methodology allowed the researcher to conduct a more reliable diagnosis of the health and work condition of the cooks. Therefore, the analysis of the real work situation throughout analytical observation and monitoring of the cooks working day routine provided much more precious information than anthropometric measurements alone.

The betterment of ergonomics factors, organizational matters, and environmental aspects can be used ultimately to promote the well-being of the staff. Simple measures that include redistribution of equipment, acquisition of materials, reorganization of tasks, as well as more complex proceedings such as physical restructuration of sectors and development of an Ergonomics Guideline Program directed to the cooks can significantly improve the quality of life at work.

Accordingly, this research confirms that in the studied kitchen, simple matters like the existence of suitable workspaces and proper levels of temperature and humidity were still a challenge. Finally, it is emphasized that the results exhibited in this study showed that when possible, the integration of different areas, in this case ergonomics, health, and nutrition is a promising way in the search of better conditions for individuals' well-being. In addition to it being beneficial to employees, these changes will also benefit the business as a whole, for healthier and happier employees will be not only more productive but also willing to take on the work effectively. They are also likely to feel satisfaction for being part of a company they feel cares for their well-being.

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APPENDIX A

NORDIC MUSCULOSKELETAL QUESTIONNAIRE (NMQ)

Musculoskeletal Disorders Survey of Kitchen Staff

Dear Interviewee

With the co-operation of your employer and the university Institutional Review Board I am conducting a survey to find out the extent to which muscle and joint aches and pains are experienced by kitchen employees.

I am interested in mild and severe problems affecting muscles, ligaments, nerves, tendons, joints, and bones suffered both at work and away from work. This could mean sprains, strains, inflammations, irritations and dislocation. For the purpose of this survey I am not interested in any injuries to the skin.

I would like you to complete this questionnaire about your health. All answers will be treated as strictly confidential and individual answers will not be made known to anyone other than the project researcher.

The more questionnaires that are completed, the greater will be the accuracy and usefulness of the findings, the better to help improve health and safety at work.

Thank you for your help.

Jaqueline Gouveia

How to Answer the Questionnaire:

Please complete this questionnaire by answering all questions as fully as possible. Some of the questions require a written answer. For others you need only tick to a box.

Based on the human picture shown on the next page, you must report the frequency of any trouble you may have, such as pain, numbness, tingling or discomfort.

You must use the following scale to answer the questions:

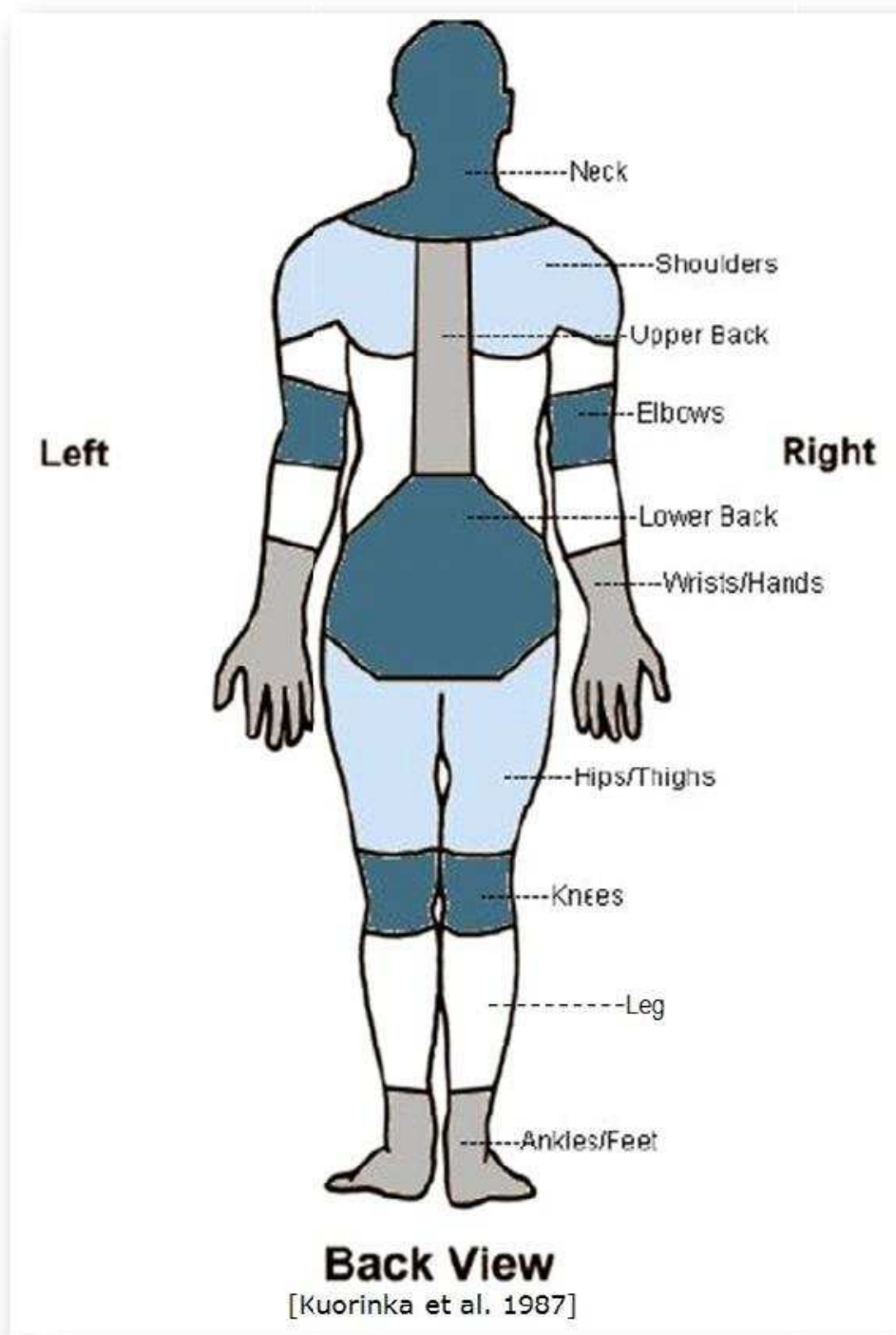
☐ 0 No
 ☐ 1 Hardly ever
 ☐ 2 Frequently
 ☐ 3 Always

Example: Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:

1. Neck	0	1	2	3
	No	Hardly ever	Frequently	Always

If you have experienced neck pain frequently, you should mark the number 2.

Musculoskeletal Disorders Survey of Kitchen Staff



Musculoskeletal Disorders Survey of Kitchen Staff

Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:

1. Neck	0	1	2	3
2. Shoulder	0	1	2	3
3. Arm	0	1	2	3
4. Elbow	0	1	2	3
5. Forearm	0	1	2	3
6. Wrists/Hands/Fingers	0	1	2	3
7. Upper Back	0	1	2	3
8. Lower Back	0	1	2	3
9. Hips/Thighs/Buttocks	0	1	2	3
10. Knee	0	1	2	3
11. Leg	0	1	2	3
12. Foot	0	1	2	3

Considering your previous answers, in which case(s) you think the symptoms are related to the work you do? You can choose more than one item.

1 None	8 Upper Back
2 Neck	9 Lower Back
3 Shoulder	10 Hips
4 Arm	11 Thigh/Buttocks
5 Elbow	12 Knee
6 Forearm	13 Leg
7 Wrists/Hands/Fingers	14 Foot

Musculoskeletal Disorders Survey of Kitchen Staff

<p>Personal Information:</p> <p>Today's date: ____/____/____.</p> <p>1. Sex: 1 Female 2 Male</p> <p>2. Age: ____.</p> <p>3. What is your weight? ____.</p> <p>4. What is your height? ____.</p> <p>5. Do you consider yourself?</p> <p> 1 Right handed 2 Left handed 3 Ambidextrous (Able to use both hands equally)</p> <p>6. How many years / months you work as a cook at this school?</p> <p> ____ years + ____ months.</p> <p>7. Have you ever worked in other kitchens?</p> <p> 1 No 2 Yes. What is the total length of time you worked on kitchens elsewhere, before working at this kitchen?</p> <p> ____.</p> <p>8. Do you have any other paid job?</p> <p> 1 No 2 Yes. What ____.</p> <p>9. On average, you work per day:</p> <p> 1 6 hours 2 8 months 3 More than 8 hours</p> <p>10. Do you rotate or change your duties regularly during the day?</p> <p> 1 No. 2 Yes (how often?). Every ____ hour(s).</p>	<p>11. Do you do any regular physical activity? (three or more times per week, at least 30 minutes)</p> <p> 1 No 2 Yes, which? ____.</p> <p>12. Select the alternatives that represent your everyday activities. You can choose more than one item:</p> <p> 1 Household chores such as cleaning, laundry, ironing, dish washing, etc. 2 Play an instrument. 3 Arts and crafts (knitting, crocheting, extensive writing, etc). 4 Use the computer. 5 Watch infants/toddlers. 6 None of the above.</p> <p>13. Select the options that correspond to any diagnosis you have been notified by a doctor in the last 12 months:</p> <p> 1 Hypothyroidism 2 Arthritis 3 Diabetes 4 Fibromyalgia 5 Spinal disc herniation 6 Scoliosis 7 Gout 8 R.S.I. (repetitive strain injury) 9 Bone fractures or accidental injury: enter the affected area: ____ ____.</p> <p>10 Other(s) ____.</p> <p>11 None of the above.</p>
<p>Thank you for your valuable contribution!</p>	

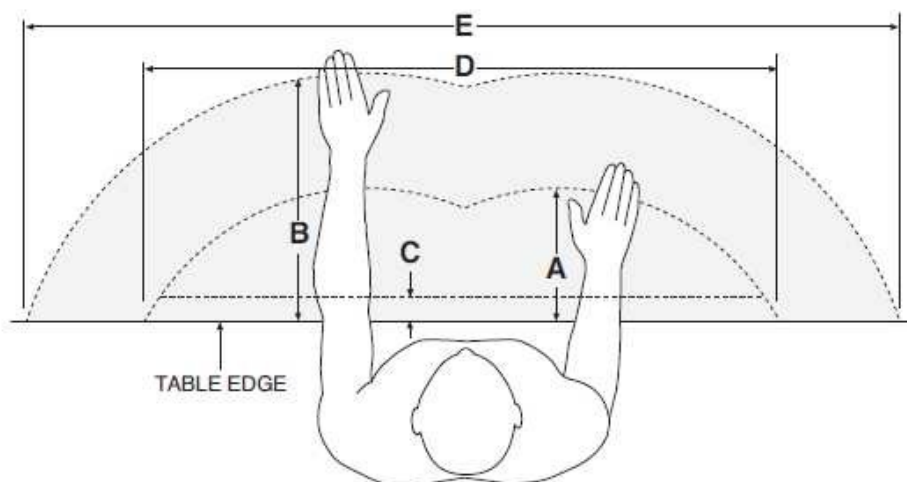
APPENDIX B

FORMS

Horizontal Work Reach Criteria Checklist

Job Name: _____
Date: _____ **Station:** _____
Site: _____ **Shift:** _____
Dept: _____ **Product:** _____

Criteria	Dimension	Measured	Acceptable?	
A. Normal Reach	Max. 12" (30 cm)	_____	Yes	No
B. Extended Reach	Max. 18" (46 cm)	_____	Yes	No
C. Work Distance	1 – 4" (2.5 – 10 cm)	_____	Yes	No
D. Normal Reach Width	Max. 40" (102 cm)	_____	Yes	No
E. Extended Reach Width	Max. 60" (152 cm)	_____	Yes	No



Seated Workstation Criteria Checklist

Job Name: _____
Date: _____ **Station:** _____
Site: _____ **Shift:** _____
Dept: _____ **Product:** _____

Criteria	Dimension	Measured	Acceptable?	
<i>Work Surface Dimensions</i>				
A. Work Height – Hands				
Light Work	Adj. 22" – 31" (56 – 79 cm)	_____	Yes	No
Data Entry	Adj. 25" – 34" (63 – 87 cm)	_____	Yes	No
Precision Work	Adj. 27" – 36" (68 – 91 cm)	_____	Yes	No
B. Display Height				
	Pref. Adj. 27" – 33" (69 cm – 84 cm) Fixed: 27" (69 cm)	_____	Yes	No
C. Work Surface Thickness				
	Max. 2" (5 cm)	_____	Yes	No
D. Knee Space Depth				
	Min. 18" (46 cm)	_____	Yes	No
E. Knee Well Width				
	Pref. 24" (61 cm) Min. 21" (53 cm)	_____	Yes	No
F. Thigh Clearance				
	Min. 8" (20 cm)	_____	Yes	No
G. Distance to Work				
	1" – 4" (2.5 – 10 cm)	_____	Yes	No
H. Foot Space Depth				
	Min. 6" (15 cm)	_____	Yes	No
I. Distance to Rear of Foot Clearance				
	Min. 24" (61 cm)	_____	Yes	No
J. Foot Space Height				
	Min. 6" (15 cm)	_____	Yes	No

Horizontal Work Reach Dimensions

A. Normal Reach	Max. 12" (30 cm)	_____	Yes	No
B. Extended Reach	Max. 18" (46 cm)	_____	Yes	No
C. Work Distance	1" – 4" (2.5 – 10 cm)	_____	Yes	No
D. Normal Reach Width	Max. 40" (102 cm)	_____	Yes	No
E. Extended Reach Width	Max. 60" (152 cm)	_____	Yes	No

Standing Workstation Criteria Checklist

Job Name: _____

Date: _____ Station: _____

Site: _____ Shift: _____

Dept: _____ Product: _____

Criteria	Dimension	Measured	Acceptable?	
Work Surface Dimensions				
A. Work Height – Hands				
Precision Work	Adj. 37" – 50" (94 – 127 cm)	_____	Yes	No
Light Assembly	Adj. 33" – 42" (84 – 107 cm)	_____	Yes	No
Heavy Work	Adj. 28" – 39" (71 – 99 cm)	_____	Yes	No
B. Rounded Edges	.08" (2 mm) radius	_____	Yes	No
C. Foot rail height	6" (15 cm)	_____	Yes	No
D. Knee Clearance	Min. 5" (13 cm)	_____	Yes	No
E. Foot Clearance Height	Min. 6" (15 cm)	_____	Yes	No
F. Foot Clearance Depth	Min. 6" (15 cm)	_____	Yes	No
G. Display Height	Pref. Adj. 54" – 68" (137 – 173 cm) Fixed: 54" (137 cm)	_____	Yes	No
Horizontal Work Reach Dimensions				
A. Normal Reach	Max. 12" (30 cm)	_____	Yes	No
B. Extended Reach	Max. 18" (46 cm)	_____	Yes	No
C. Work Distance	1" – 4" (2.5 – 10 cm)	_____	Yes	No
D. Normal Reach Width	Max. 40" (102 cm)	_____	Yes	No
E. Extended Reach Width	Max. 60" (152 cm)	_____	Yes	No
Other Standing Workstation Criteria				
Head Clearance	Min. 80" (203 cm)	_____	Yes	No
Horizontal Viewing Area	15° to either side of work area	_____	Yes	No
Normal Line of Sight	15° below horizontal plane	_____	Yes	No
Optimum Viewing	± 15° from normal line of sight	_____	Yes	No
Anti-fatigue Matting	Min. .5" (1.3 cm) thickness	_____	Yes	No

Material Handling Criteria Checklist

Job Name: _____

Date: _____

Station: _____

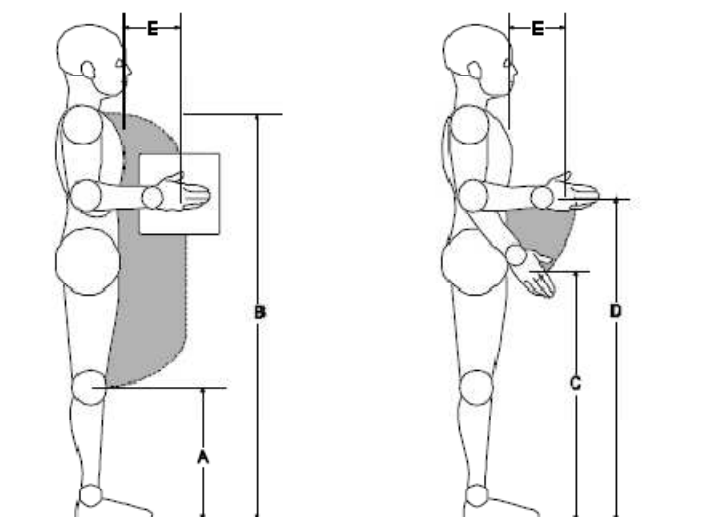
Site: _____

Shift: _____

Dept: _____

Product: _____

Criteria	Dimension	Measured	Acceptable?
A. Comfort Zone Bottom	Min. 22" (56 cm)	_____	Yes No
B. Comfort Zone Top	Max. 49" (124 cm)	_____	Yes No
C. Optimal Comfort Zone Bottom	Min. 33" (84 cm)	_____	Yes No
D. Optimal Comfort Zone Top	Max. 38" (97 cm)	_____	Yes No
E. Distance From Body (to midpoint of hands)	Max. 6" (15 cm)	_____	Yes No



APPENDIX C

NIOSH LIFTING EQUATION AND CARRY GUIDELINES

Humantech® CLEAR

NIOSH Lifting Guidelines		DESCRIPTION
Job Title <input style="width: 600px;" type="text"/>		
Model Inputs: Horizontal Location (H) <input style="width: 50px;" type="text"/> in <small>(min 10", max 25")</small> Vertical Location (V) <input style="width: 50px;" type="text"/> in <small>(min 0", max 70")</small> Travel Distance (D) <input style="width: 50px;" type="text"/> in <small>(min 10", max 70")</small> Angle of Asymmetry (A) <input style="width: 50px;" type="text"/> deg <small>(min 0°, max 135°)</small> Coupling <input style="width: 50px;" type="text"/> <small>(1=good, 2=fair, 3=poor)</small> Duration <input style="width: 50px;" type="text"/> hr(s) <small>(Enter 1, 2 or 8 hrs. only)</small> Frequency <input style="width: 50px;" type="text"/> l/m <small>(min 0.2, max 15 lifts/min)</small> Average Load Weight <input style="width: 50px;" type="text"/> lb Maximum Load Weight <input style="width: 50px;" type="text"/> lb	Enter Data: <input style="width: 50px;" type="text"/> in <small>(10" is best)</small> <input style="width: 50px;" type="text"/> in <small>(30" is best)</small> <input style="width: 50px;" type="text"/> in <small>(10" is best)</small> <input style="width: 50px;" type="text"/> deg <small>(0 is best)</small> <input style="width: 50px;" type="text"/> <small>(1 is best)</small> <input style="width: 50px;" type="text"/> hr(s) <small>(1 is best)</small> <input style="width: 50px;" type="text"/> l/m <small>(0.2 is best)</small> <input style="width: 50px;" type="text"/> lb <input style="width: 50px;" type="text"/> lb	Multipliers: HM = <input style="width: 50px;" type="text"/> VM = <input style="width: 50px;" type="text"/> DM = <input style="width: 50px;" type="text"/> AM = <input style="width: 50px;" type="text"/> CM = <input style="width: 50px;" type="text"/> Dur = <input style="width: 50px;" type="text"/> FM = <input style="width: 50px;" type="text"/> Model Outputs: Recommended Weight Limit (RWL): <div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto;"></div> lb. Lifting Index (LI = Load/RWL): <div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto; text-align: center;">0.00</div> <hr/> Frequency Independent RWL: <div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto;"></div> lb. Frequency Independent LI: <div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto; text-align: center;">0.00</div> <hr/> Recommendations: <div style="background-color: yellow; height: 100px; width: 100%;"></div>



THE MENU FOR ELEMENTARY AND HIGH SCHOOL

MAY OF 2011

	Monday	Tuesday	Wednesday	Thursday	Friday
Meal	3- Milk, cereal (corn flakes) and a banana.	14- Bean stew with pork, rice, carrots, chicory salad with orange.	13- Rice, beans, chopped meat with tomato sauce, baked cassava, cabbage, and beet salad.	9- Pineapple juice and carrot cake.	17.a- Rice, beans, chicken stew (drumsticks), cauliflower cooked with cabbage, and carrot salad.
	Monday	Tuesday	Wednesday	Thursday	Friday
Meal	19- Rice, beans, ground beef, mashed potatoes, lettuce and tomato salad.	15- Rice, beans, beef steak, pasta with tomato sauce, and salad of spinach with grated carrot.	8. b- Grape juice and chicken sandwich, carrots, corn, peas, and tomato sauce.	4.a- Milk shake with apple, papaya and oatmeal, sweet bread with organic banana preserves.	12. b- Rice, beans, polenta Magdalene (polenta stuffed with shredded chicken and sauce), coleslaw, and beetroot.
	Monday	Tuesday	Wednesday	Thursday	Friday
Meal	1- Milk chocolate, honey cookies or animal crackers, and an apple.	16. b- Rice, beans, boiled egg, spinach sautéed, pumpkin puree, and coleslaw.	20- Rice, beans, sliced beef stew, potato sautéed with peas, spinach salad, and chayote.	7- Orange juice, vegetable pie (grated cheese, corn, eggs, carrots, green peas, and spices).	11- Rice, beans, carrot omelet, rotini pasta with parsley, and lettuce and tomato salad.
	Monday	Tuesday	Wednesday	Thursday	Friday
Meal	3.a- Fruit salad with yogurt and oatmeal.	18. c- Beef scup (rice, potato, pumpkin, chayote, spinach, onion, tomato, and garlic) and two slices of sandwich bread.	17- Rice, beans, grilled or roast chicken (drumstick), creamed corn, and chicory and tomato salad.	8- Pineapple juice and hot dog with corn and peas.	18. b- Rice, beans, fish stew, potatoes, pasta, spinach and chayote salad.